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TRANSPORTATION RESEARCH COM

FORT EUSTIS, VIRGINIA

CRASH INJURY BULLET

STRENGTH ANALYSIS
OF CARRIAGE ATTACHMENT FITTI
ON CREW SEATS, HU-1 AIRCRAF
AND
RECOMMENDATIONS FOR IMPROVE

October 1962

Contract DA-44-177-TC-802 *TCREC T*

prepared by:

AVIATION CRASH INJURY RESEARCH
PHOENIX, ARIZONA
A DIVISION OF
FLIGHT SAFETY FOUNDATION, INC.
NEW YORK, NEW YORK
FSF

U. S. ARMY

TRANSPORTATION RESEARCH COMMAND

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STRENGTH ANALYSIS OF CARRIAGE ATTACHMENT FITTING ON CREW SEATS, HU-1 AIRCRAFT AND RECOMMENDATIONS FOR IMPROVEMENT

October 1962

Contract DA-44-177-TC-802

TCREC Technical Report 62-84

prepared by :

AVIATION CRASH INJURY RESEARCH
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TRANSPORTATION CORPS
Fort Eustis, Virginia

This report was prepared by Aviation Crash Injury Research (AvCIR), a division of the Flight Safety Foundation, Inc., under the terms of Contract DA 44-177-TC-802. Views expressed in the report have not been reviewed or approved by the Department of the Army; however, conclusions and recommendations contained therein are concurred in by this Command.

The United States Army Board for Aviation Accident Research (USABAAR) published a report, "HU-1 Seat Failures, A Report of Four Cases, Special Report", in 1961 in which it was stated that of seven accidents occurring during the period 1 January 1960 - 31 August 1960, where impact forces were considered moderate-to-severe, crew seat failures occurred in 57 percent of the cases. Predominant among these failures was failure of the carriage attachment fitting. A review of HU-1 accident experience subsequent to the period covered by the USABAAR report indicates a continuance of this trend.

A detailed stress analysis of the carriage attachment fitting was conducted by AvCIR personnel. Based on the findings of this analysis, a simple, economical and practical modification was devised which will reduce stresses in the fitting by a factor of approximately two. Results of the analysis, a detailed description and drawing of the modification, and results of comparison tests between the existing fitting and the modified fitting are contained in this report.

This report has been forwarded to Headquarters, U. S. Army Mobility Command, requesting that immediate action be taken to implement the recommendation of the Contractor in this instance.

FOR THE COMMANDER:

Kenneth B. Abel
KENNETH B. ABEL
Captain TC
Adjutant

APPROVED BY:

William J. Nolan
WILLIAM J. NOLAN
USATRECOM Project Engineer

Task 9R95-20-001-01
Contract DA 44-177-TC-802
October 1962

STRENGTH ANALYSIS OF CARRIAGE ATTACHMENT FITTING ON CREW SEATS, HU-1 AIRCRAFT, AND RECOMMENDATIONS FOR IMPROVEMENT

Crash Injury Bulletin
AvCIR 62-11

Prepared by
Aviation Crash Injury Research
A Division of
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for

U. S. ARMY TRANSPORTATION RESEARCH COMMAND
FORT EUSTIS, VIRGINIA

CRASH INJURY BULLETIN

by

J. P. Avery, Ph. D., Engineering

CONTENTS

SUMMARY

The crew seat of the HU-1A aircraft has failed frequently in survivable type accidents, with the primary failure occurring in the carriage attachment fitting (Part Number 204-070-742-1). The most recent accident occurred at Fort Carson, Colorado, 7 May 1962 (reference TCREC Technical Report 62-87*). Analysis discloses that occupant inertia load of the order of 11G could have caused these failures.

A simple field modification is presented which would reduce stresses in the fitting by a factor of approximately two. No new parts need to be manufactured; two AN bolts and one NAS spacer are the only new parts required.

CONCLUSION

On the basis of accident evidence and a detailed stress analysis of the existing attachment fitting, it is concluded that the fitting is excessively stressed due to the moment fixity of its connection to the carriage channel. Consequently, it presents a weak link in the tiedown chain (seat belt, seat belt anchorage, shoulder harness and anchorage, seat structure, seat anchorages, and floor).

RECOMMENDATION

Based upon the disclosures of the analysis, it is recommended that the proposed field modification (shown in Appendix III, AvCIR Drawing HU-1-12) be incorporated on all HU-1A and HU-1B aircraft.

---

* TCREC Technical Report 62-87, U. S. Army HU-1A Bell Iroquois Helicopter Accident, U. S. Army Transportation Research Command, Fort Eustis, Virginia, November 1962.

GENERAL CONSIDERATIONS

The fitting failures appear to have occurred as a consequence of combined axial tension and bending moment acting at a region of stress concentration (at the base of the shoulder, indicated in Figure 1). The bending moment exists due to the fixity provided by the three fitting bolts which secure the fitting to the carriage channel (Part Number 204-070-713-13).

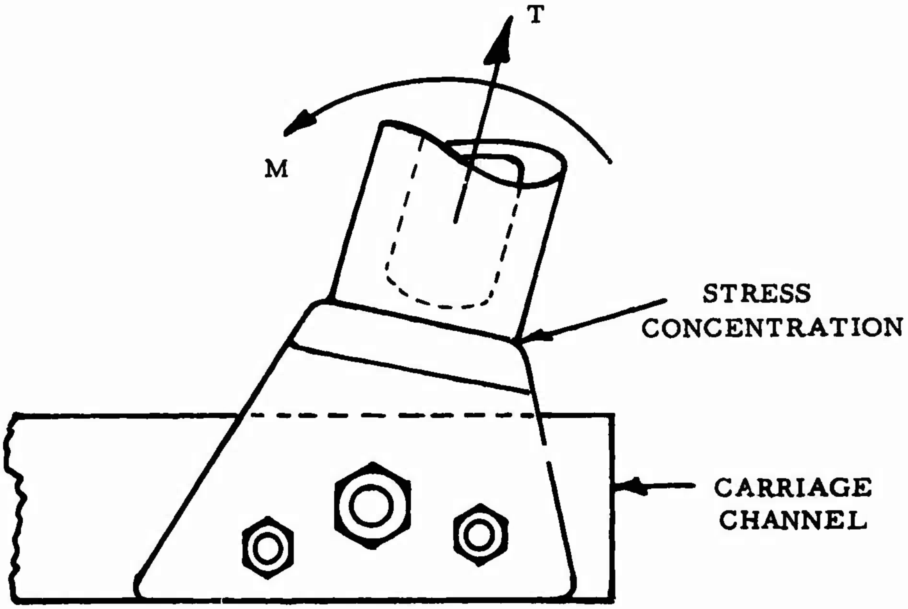


Figure 1. Aft Carriage Attachment Fitting.

As a field modification (shown in Appendix III, AvCIR Drawing HU-1-12), it is proposed that the bending moment be relieved by cutting the casting free from attachment bolts A and C as indicated in Figure 2, thus providing a pinned end connection rather than a "moment" connection.

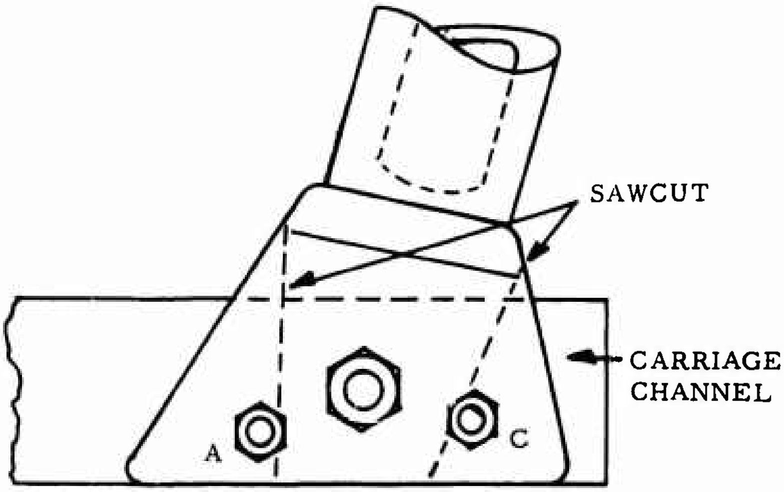


Figure 2. Aft Carriage Attachment Fitting Modification.

The stress analyses of the existing casting and the proposed field-modified casting appear in Appendixes I and II. In both of these stress analyses, the seat load has been taken as that of an occupant and seat weighing 220 pounds under decelerations sufficient to cause failure. Two directions of the inertia load have been considered: Case I (no vertical load present), a longitudinal load combined with a lateral load of half the value of the longitudinal component; Case II, a combination of longitudinal and vertical loads of equal values together with a lateral load of half the magnitude of their resultant. Case I presents the more severe load condition with respect to the fitting and, hence, deserves primary consideration. Case II loading is also considered, as it represents the more frequently encountered condition of a crash impact upon the HU-1 aircraft.

The presence of a lateral load component introduces an indeterminacy in the internal seat forces; hence, an exact analysis for it is lacking. However, an approximate analysis (see Appendix I, paragraph A) is afforded by making reasonable simplifying assumptions.

For the purpose of evaluating a modification improvement factor, the critical seat position for each load case is considered.

ANALYSIS RESULTS

The analysis results may be summarized as follows:

For Case I (Longitudinal and lateral load)

Failure acceleration for present design	-	10.9G
Failure acceleration for modified fitting	-	19.8G

Thus, the factor of improvement is calculated to be 1.82.

For Case II (Combined longitudinal, lateral, and vertical load)

Failure acceleration for present design	-	11.2G
Failure acceleration for modified fitting	-	22.4G

The factor of improvement for this case is found to be 2.0.

It should be noted that the preceding factors of improvement pertain only to the fitting and its connections with adjoining parts. Upon improvement of the fitting, other seat structure components might then govern the load-carrying capacity of the seat.

EXPERIMENTAL VERIFICATION

As an experimental check upon assumptions made in the stress analysis and failure criterion, tests were performed on fittings in which a combined tension load and a bending moment were applied in a constant ratio up to fitting failure. The ratio (of tensile force to bending moment) used was the average value associated with Case I, the longitudinal and lateral load condition. Comparison tests were performed on modified fittings to obtain the tensile force at failure after modification. Figures 3 through 7 show the test setup in each case and typical failed fittings from the tests.

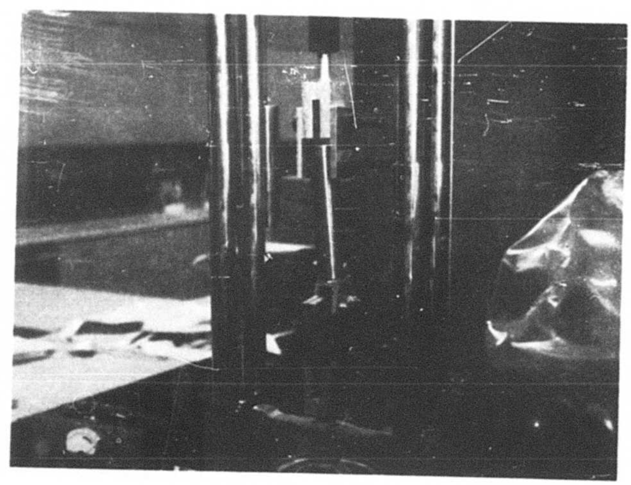


Figure 3. Test Setup for Applying Tensile and Bending Stresses. (Simulates existing load conditions.)

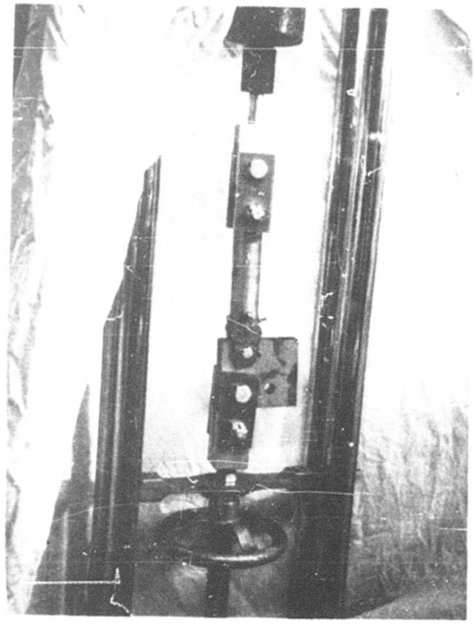
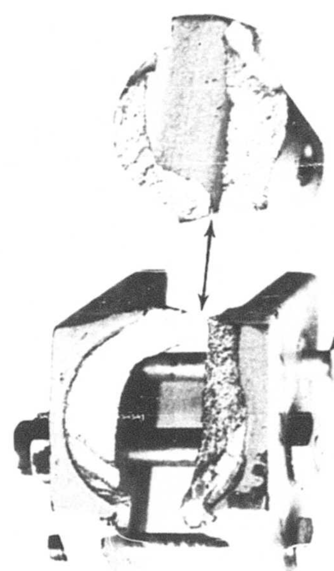


Figure 4. Test Setup for Applying Tensile Stresses. (Simulates load on modified casting.)

Figure 5. Failed Casting From HU-1A Accident, Ft. Carson, Colorado, 7 May 1962. (Arrows in Figures 5 and 6 show probable origin of failures.)



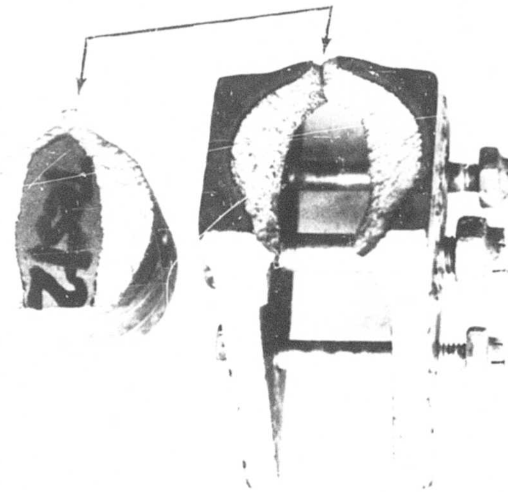


Figure 6. Failed Casting From Test Setup (Figure 3).

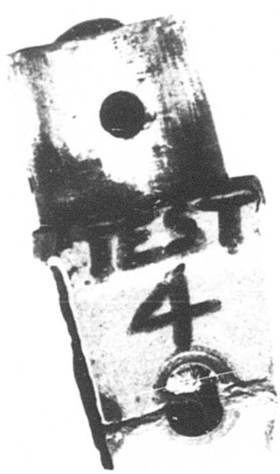


Figure 7. Failed Casting With Recommended Changes Incorporated.

For the full-up seat position of Case I, the calculated failure acceleration is 10.9G, the associated bending moment is 3,980 inch-pounds, and the tensile force is 4,130 pounds. A comparison between computed values and those obtained at fitting failure under tests (designed to simulate theoretical load conditions) is presented in Table 1.

TABLE 1
COMPARISON BETWEEN COMPUTED AND TEST FAILURE LOADS FOR EXISTING FITTING

	Computed	Experimental		
		Test I	Test II	Average of Tests I and II
Bending Moment (in-lb)	3,980	3,770	4,190	3,980
Tensile Force (lb)	4,130	3,710	4,120	3,915
Nominal Stress (psi)	34,000	32,000	35,500	33,750

Two modified fittings were subjected to simple tension, with the following results:

TABLE 2
COMPARISON BETWEEN COMPUTED AND TEST FAILURE LOADS FOR MODIFIED FITTING

	Computed	Experimental		
		Test I	Test II	Average of Tests I and II
Tensile Force (lb)	7,500*	8,480	6,880	7,680

* Note: The computed ultimate tensile force is based upon bearing strength as given by MIL-HDBK-5, while the experimental failures actually occurred in tension across the minimum area section. Attention is called to the fact that the lower experimental tensile stress is only 21.5 ksi, which is 63 percent of the tabulated value of 34 ksi for this material.

Since the tensile load in the aft seat leg is proportional to the applied inertia G-load, the factor of improvement may be obtained as a ratio of ultimate tensile loads. From experimental averages, we have a nominal stress of 33,750 psi, which, if based upon the computed moment-to-force ratio, would correspond to a tensile load of 4,100 pounds.

	Existing Fittings	Modified Fittings
Average ultimate tensile load (lb)	4,100	7,680

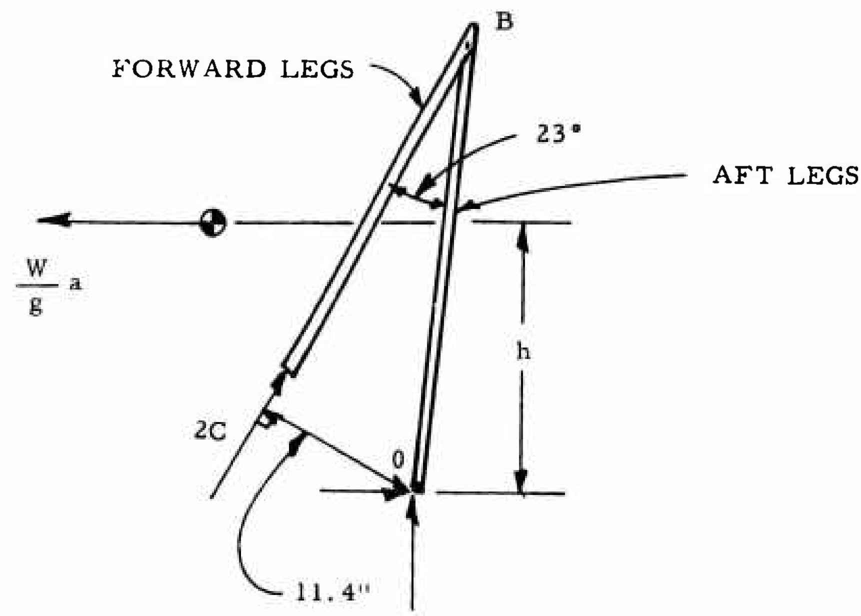
Thus, the experimental factor of improvement is 1.87 as compared with the computed value of 1.82.

APPENDIX I. STRESS ANALYSIS OF FITTING (PART NUMBER 204-070-742-1) IN EXISTING SEAT DESIGN

A. Case I loading: (Inertia load in the longitudinal direction)

1. Tensile Stress

Consider the free body diagram shown:



where:

$\frac{W}{g}a$ = inertia force of occupant (longitudinal)

C = axial compressive force in forward leg

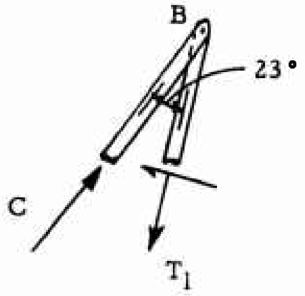
Then, considering moments about point O,

$$(2C)(11.4) = \frac{W}{g}ah$$

or

$$C = \frac{W}{g}a\frac{h}{22.8}$$

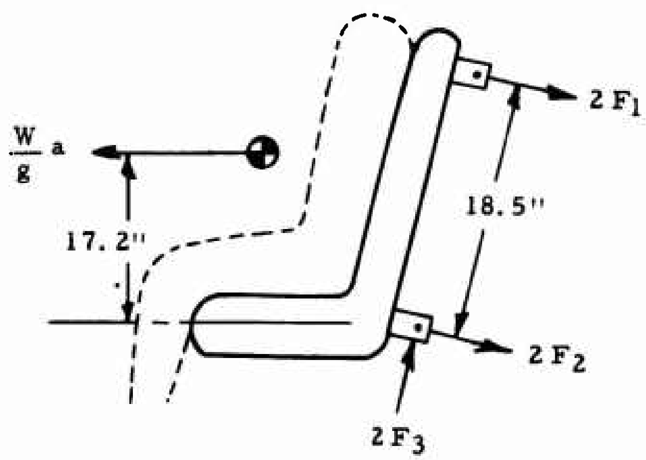
Consider next, pin connection B at top of legs.



Tension T_1 is then

$$T_1 = C \cos 23° = C(.92) = \frac{W}{g} a \; \frac{h(.92)}{22.8}$$

Next consider the seat bucket and occupant as a free body,

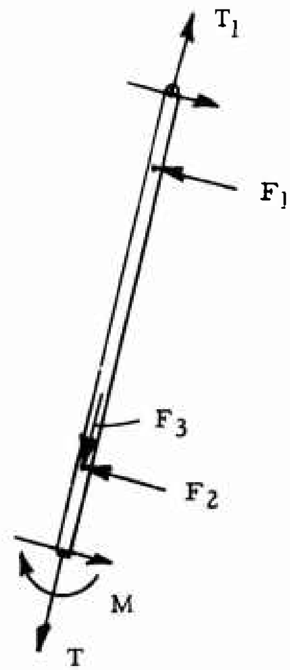


From a graphical solution, we find:

$$F_1 = .465 \frac{W}{g} a; \qquad F_2 = .023 \frac{W}{g} a; \qquad F_3 = .115 \frac{W}{g} a$$

The location of the occupant's unloaded center-of-mass was obtained from MIL-S-5822 (USAF), but a five-inch forward displacement was used due to harness elongation and forward flexing of the body.

The forces acting on one aft leg are then indicated as follows:



Hence, $T = T_1 - F_3 = \left(\frac{.92}{22.8} h - .115\right) \frac{W}{g} a.$

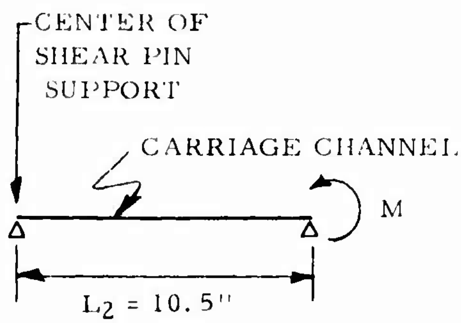
The tensile stress $\sigma_t = \frac{T}{A} = \frac{T}{.73}$.

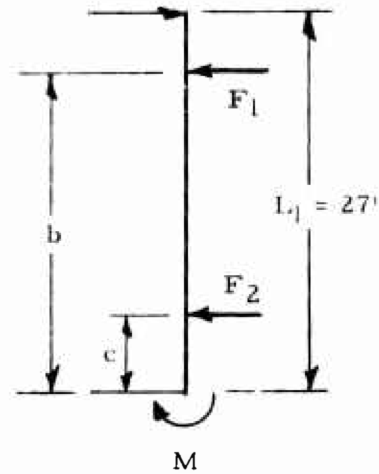
For various seat positions, then, we have

Seat Position	"h"	T	σ_t
Full down	20.1	$.695 \frac{W}{g} a$	$.95 \frac{W}{g} a$
Med. low	22.1	$.775 \frac{W}{g} a$	$1.06 \frac{W}{g} a$
Med. high	24.1	$.855 \frac{W}{g} a$	$1.17 \frac{W}{g} a$
Full up	25.35	$.905 \frac{W}{g} a$	$1.24 \frac{W}{g} a$

2. Bending Stress from Longitudinal Load

To calculate the bending moment at the fitting, the aft seat leg is assumed to be simply supported at the upper end and moment connected to the carriage channel (204-070-713-13) at the lower end.





From a standard indeterminate beam analysis, the bending moment M is found to be

$$M = \frac{1}{1 + \dfrac{(EI)_1 L_2}{(EI)_2 L_1}} \left\{ \frac{F_1}{2} b \left[2 - 3\frac{b}{L_1} + \left(\frac{b}{L_1}\right)^2 \right] + \frac{F_2}{2} c \left[2 - 3\frac{c}{L_1} + \left(\frac{c}{L_1}\right)^2 \right] \right\}$$

where $(EI)_1$ = flexural rigidity of aft leg cross-section.

$(EI)_2$ = flexural rigidity of carriage channel cross-section.

For the cross-section through the circular portion of the fitting (through which the moment M is transmitted), the section modulus is calculated to be

$$\frac{I}{c} = .14 \text{ in.}^3$$

Hence, the maximum bending stress in the casting is

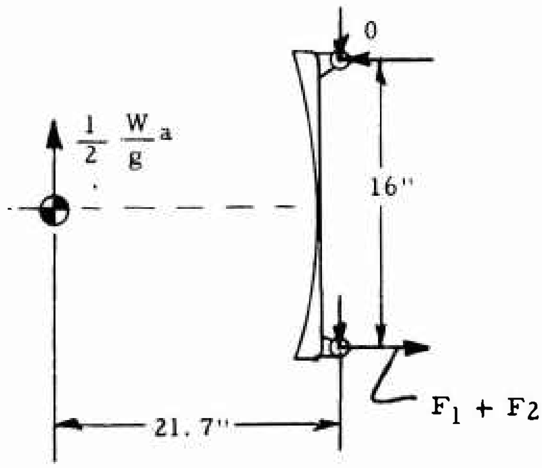
$$\sigma_B = \frac{Mc}{I} = \frac{M}{.14}$$

For the four seat positions considered, we find

Seat Position	c	b	M	σ_B
Full down	2	20.5	$.73 \frac{W}{g} a$	$5.2 \frac{W}{g} a$
Med. low	4	22.5	$.54 \frac{W}{g} a$	$3.86 \frac{W}{g} a$
Med. high	6	24.5	$.33 \frac{W}{g} a$	$2.36 \frac{W}{g} a$
Full up	7.25	25.75	$.23 \frac{W}{g} a$	$1.64 \frac{W}{g} a$

3. <u>Bending Stresses from Lateral Load</u>

Consider a plan view (looking parallel to aft seat leg) of seat bucket and occupant taken as a free body.



Summing moments about point O, we obtain

$$F_1 + F_2 = .68 \frac{W}{g} a.$$

The distribution of this force between the top and bottom attachments to the left aft leg depends upon the torsional stiffness of the seat bucket. By means of the lap belt and friction forces, the occupant is assumed to apply the seat torque to the bottom of the seat bucket. The seat bucket, in turn, is computed to have a very low torsional rigidity; hence, a negligible force is assumed to be transmitted through the upper attachments to the aft legs. Thus,

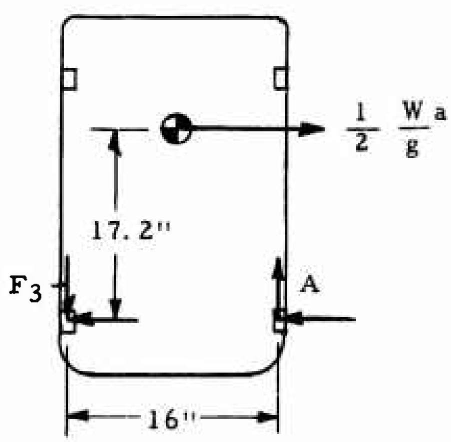
$$F_1 = 0, \quad F_2 = .68 \frac{W}{g} a .$$

Employing the expression for bending moment given in the previous section, the bending stresses are computed to be

Seat Position	M	σ_B
Full down	$.60 \frac{W}{g} a$	$4.31 \frac{W}{g} a$
Med. low	$1.07 \frac{W}{g} a$	$7.66 \frac{W}{g} a$
Med. high	$1.41 \frac{W}{g} a$	$10.08 \frac{W}{g} a$
Full up	$1.62 \frac{W}{g} a$	$11.52 \frac{W}{g} a$.

4. Tensile Stress from Lateral Load

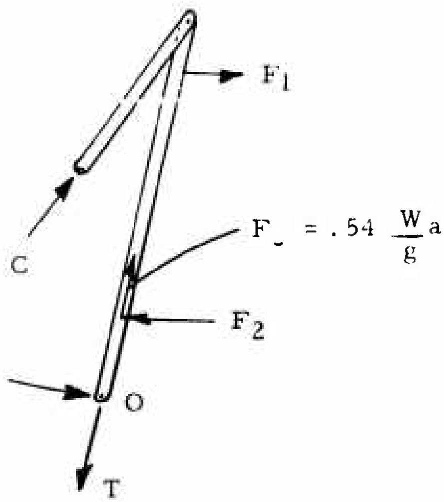
Consider a view looking forward of a seat bucket and occupant taken as a free body.



No lateral forces are assumed to act at the upper attachments to the aft legs due to the lateral flexibility of the leg frame. The vertical force F_3 at the lower attachment (through retaining pin) may then be calculated by considering moments about point A. We obtain

$$F_3 = .54 \frac{W}{g} a .$$

Next, consider a left aft leg as a free body.



As shown in the preceding section,

$$F_1 = O \qquad F_2 = .68 \frac{W}{g} a .$$

Then, taking moments about point O,

$$C(11.4) = F_2 d$$

$$\text{or} \quad C = \frac{.68}{11.4} d \frac{W}{g} a .$$

Summing forces along the leg,

$$T = (.975) C + F_3$$

$$T = \left[\frac{(.975)(.68)}{(11.4)} d + .54\right] \frac{W}{g} a .$$

The tensile stresses are computed for the four seat positions considered as follows:

Seat Position	d	T	σ_t
Full down	3	$.71 \frac{W}{g} a$	$.97 \frac{W}{g} a$
Med. low	5	$.83 \frac{W}{g} a$	$1.03 \frac{W}{g} a$
Med. high	7	$.95 \frac{W}{g} a$	$1.30 \frac{W}{g} a$
Full up	8.25	$1.02 \frac{W}{g} a$	$1.40 \frac{W}{g} a$

5. Stress Concentration

For an abrupt change in section with negligible fillet, the "stress concentration" factor at rupture is found to be approximated by 1.00 (see Formulas for Stress and Strain, Roark, Table XVII, parts 11 and 3). Hence, rupture is predicted when the combined tensile and bending stresses as calculated above reach the ultimate strength of the material.

For AZ 91C - T4, $F_{tu} = 34,000$ psi.

Hence, for full-down seat position and weight of occupant plus seat of 220 pounds, we have

$$.95 \frac{W}{g} a + 5.2 \frac{W}{g} a + .97 \frac{W}{g} a + 4.31 \frac{W}{g} = 34,000$$

$$11.43\, a = \frac{34,000}{220} g$$

and $$a = 13.5\, g.$$

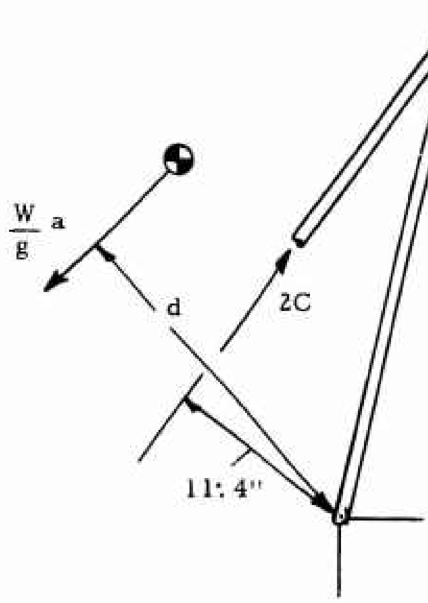
This, however, is based upon the longitudinal component of acceleration only. When added vectorially to the lateral component of half its magnitude, we have the resultant acceleration of 15.1 times gravity acceleration. Thus, for the various seat positions,

Seat Position	Failure Acceleration
Full down	15.1G
Med. low	12.7G
Med. high	11.6G
Full up	10.9G

B. Case II Loading: (Equal longitudinal and vertical load components together with a lateral load of half their resultant)

1. <u>Tensile Stress</u>

Consider the following free body diagram:



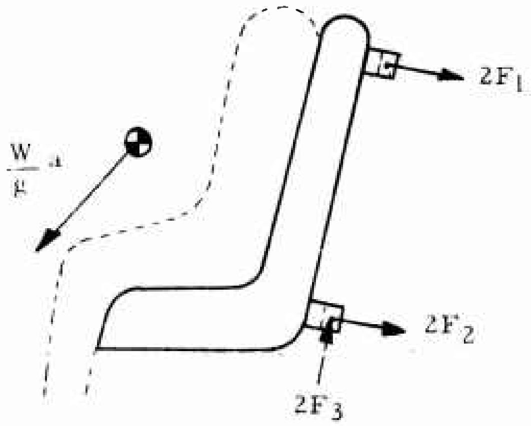
(The occupant's C.G. is located as per MIL-S-5822, considering a 5-inch forward deflection and a 2-1/2-inch downward deflection under the full load condition.)

As with load case I, we find

$$C = \frac{W}{g} a \frac{d}{22.8}$$

and $$T_1 = \frac{W}{g} a \frac{d(.92)}{22.8}$$

The seat and bucket free body diagram becomes



A graphical solution yields

$F_1 = .623 \frac{W}{g} a; \quad F_2 = -.36 \frac{W}{g} a; \quad F_3 = .42 \frac{W}{g} a.$

The tensile force on the fitting is then

$$T = T_1 - F_3 = \left(\frac{.92}{22.8} d - .43 \right) \frac{W}{g} a.$$

For various seat positions, then

Seat Position	d	T	σ_t
Full down	24.6	$.57 \frac{W}{g} a$	$.78 \frac{W}{g} a$
Med. low	25.7	$.61 \frac{W}{g} a$	$.84 \frac{W}{g} a$
Med. high	26.7	$.65 \frac{W}{g} a$	$.89 \frac{W}{g} a$
Full up	27.4	$.68 \frac{W}{g} a$	$.93 \frac{W}{g} a$

2. <u>Bending Stresses</u>

As with load case I analysis,

$$M = \frac{1}{1 + \frac{(EI)_1 L_2}{(EI)_2 L_1}} \left\{ \frac{F_1}{2} b \left[2 - 3 \frac{b}{L_1} + \left(\frac{b}{L_1} \right)^2 \right] + \frac{F_2}{2} c \left[2 - 3 \frac{c}{L_1} + \left(\frac{c}{L_1} \right)^2 \right] \right\}$$

For the seat positions considered, therefore,

Seat Position	c	b	M	σ_B
Full down	2	20.5	$.63 \frac{W}{g} a$	$4.5 \frac{W}{g} a$
Med. low	4	22.5	$.113 \frac{W}{g} a$	$.80 \frac{W}{g} a$
Med. high	6	24.5	$-.37 \frac{W}{g} a$	$2.64 \frac{W}{g} a$
Full up	7.25	25.75	$-.62 \frac{W}{g} a$	$4.43 \frac{W}{g} a$.

With stresses from the lateral load superimposed considering signs (part A, sections 3 and 4), the total combined stresses and resulting failure accelerations are computed to be

Seat Position	Combined Stress	Failure Acceleration
Full down	$10.56 \frac{W}{g} a$	16.3G
Med. low	$10.33 \frac{W}{g} a$	16.6G
Med. high	$12.31 \frac{W}{g} a$	14.1G
Full up	$15.48 \frac{W}{g} a$	11.2G

APPENDIX II. PROPOSED MODIFICATION OF FITTING PART NUMBER 204-070-742-1 AND STRESS ANALYSIS OF MODIFIED PART

A. Modification

The fitting would be modified as follows:

(a) Cut along lines indicated on AvCIR Drawing HU1-12.

(b) Cut-off portions are to be reinstalled to maintain side support for carriage channel.

(c) Replace the .25-diameter bolt through carriage channel with .31-diameter bolt and appropriate bushing.

(d) Add a .19-diameter bolt perpendicular to the .25-diameter bolt in the connection to the tube (Part Number 204-070-706-11).

B. Analysis for Case I Loading (Inertia load in the longitudinal direction)

The modified fitting would be pin connected; hence, only tensile forces are significant. The failure tensile forces are computed below for various failure modes:

(Strength criteria are taken from MIL-HDBK-5, 1959.)

(1) Crushing strength at .31-diameter lower fitting bolt:

Projected area = (.24) (.3125) (2) = .15 square inch

F_{bru} = 50,000 psi. Hence, the ultimate tensile load is

$T_{ult} = AF_{bru} = (.15)(50,000)$

$T_{ult} = 7,500$ pounds.

(2) Shear strength in .31-diameter lower fitting bolt.

Ultimate single shear force for AN-5 bolt is given as 5,750 pounds.

Since two surfaces are in shear,

$T_{ult} = (2)(5750) = \underline{\underline{11,500 \text{ pounds.}}}$

(3) Crushing strength of fitting material at .25-diameter bolt and .19-diameter bolt in connection to steel tube.

Projected area for .25-diameter bolt = (.25)(.25)(2)
= .125 square inch.

Projected area for .19-diameter bolt = (.19)(.25)(2)
= .095 square inch

For AZ91C, F_{bru} = 50,000 psi. Hence,

$T_{ult} = (.125 + .095)(50,000) = \underline{\underline{11,000 \text{ pounds.}}}$

(4) Crushing strength of tube at .25-diameter bolt and .19-diameter bolt in connection to tube.

Projected area for .25-diameter bolt = (.25)(.058)(2)
= .29 square inch

Shear-out area for .19-diameter bolt = (.2)(.058)(4)
= .0465 square inch

For 4130 steel heat treated to 150 ksi,

F_{bru} = 287,000 psi.

Hence, for the .25-diameter bolt,

T_{ult} = (.029)(287,000) = 8,320 pounds.

For 4130 steel heat treated to 150 ksi, the ultimate shear strength is

F_{su} = 95,000 psi.

Hence, for the .19-diameter bolt,

T_{ult} = (.0465)(95,000) = 4,400 pounds.

Thus, the total tensile load is

$$T_{ult} = 8,320 + 4,400 = \underline{\underline{12,720 \text{ pounds.}}}$$

(5) Shear strength in .25-diameter bolt and .19-diameter bolt in connection to steel tube.

Ultimate single shear strength of AN-4 bolt = 3,680 pounds.

Ultimate single shear strength of AN-3 bolt = 2,126 pounds.

For two surfaces in shear in each bolt,

$$T_{ult} = (2)(3680) + (2)(2126) = \underline{\underline{11,600 \text{ pounds.}}}$$

(6) Tensile strength at minimum cross section adjacent to .31-diameter lower fitting bolt.

Cross-section area = (.66)(.24)(2) = .32 square inch

For AZ91C, ultimate tensile strength is 34,000 psi. Hence,

$$T_{ult} = (.32)(34,000) = \underline{\underline{10,900 \text{ pounds.}}}$$

Of the above failure modes, crushing at the .31-diameter lower fitting bolt is critical. Hence, the tensile capacity of the attachment fitting is 7,500 pounds.

Referring to Appendix I, part A, tensile forces are given in terms of longitudinal inertia load as follows:

Seat Position	T
Full down	$1.405 \frac{W}{g} a$
Med. low	$1.605 \frac{W}{g} a$
Med. high	$1.805 \frac{W}{g} a$
Full up	$1.925 \frac{W}{g} a$

Equating values of T to 7, 500 pounds, the failure accelerations are found to be

Seat Position	Resultant Failure Acceleration
Full down	27.1G
Med. low	22.9G
Med. high	21.2G
Full up	19.8G

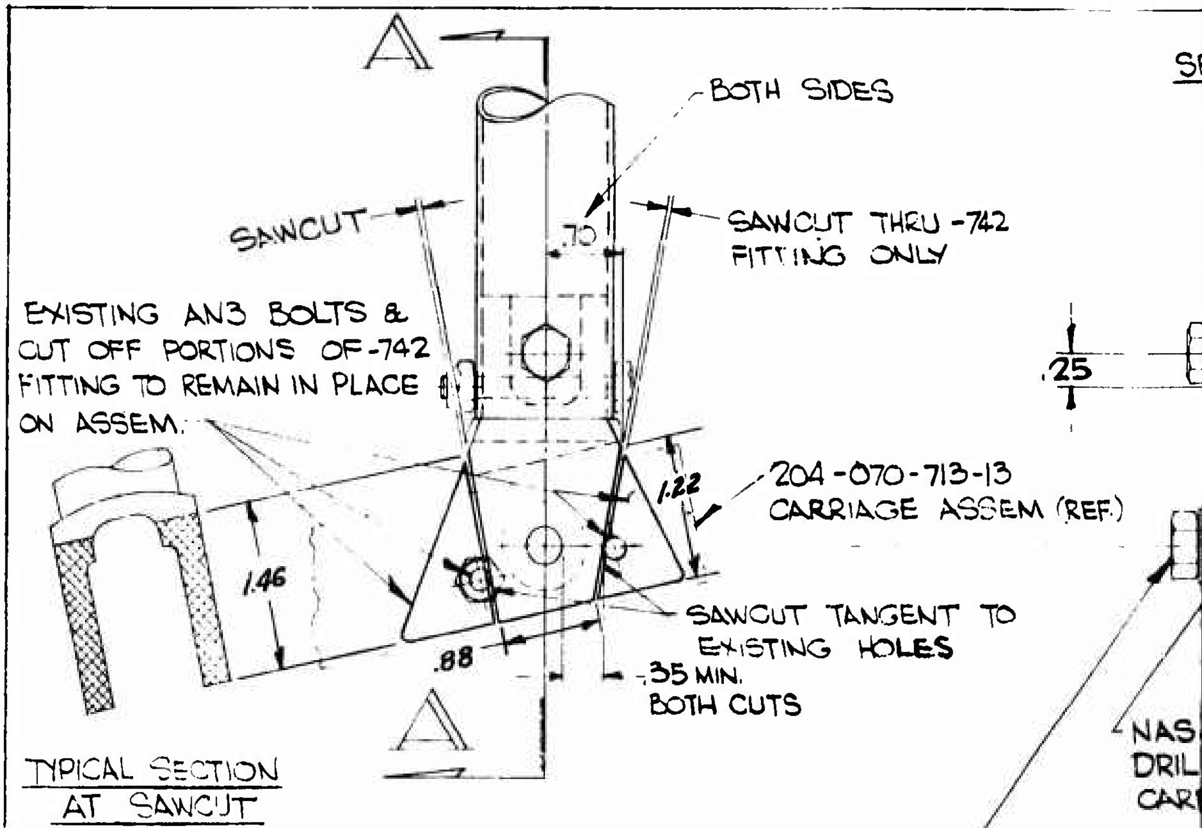
C. <u>Analysis for case II loading (Combined longitudinal and vertical inertia loads, with lateral load present)</u>

The governing ultimate tensile load is again 7, 500 pounds as calculated in part B. Referring to Appendix I, part B, tensile forces, T, are given in terms of inertia loads as follows:

Seat Position	T
Full down	$1.28 \frac{W}{g} a$
Med. low	$1.44 \frac{W}{g} a$
Med. high	$1.60 \frac{W}{g} a$
Full up	$1.70 \frac{W}{g} a$

Equating these values of T to 7, 500 pounds, the failure accelerations are found to be

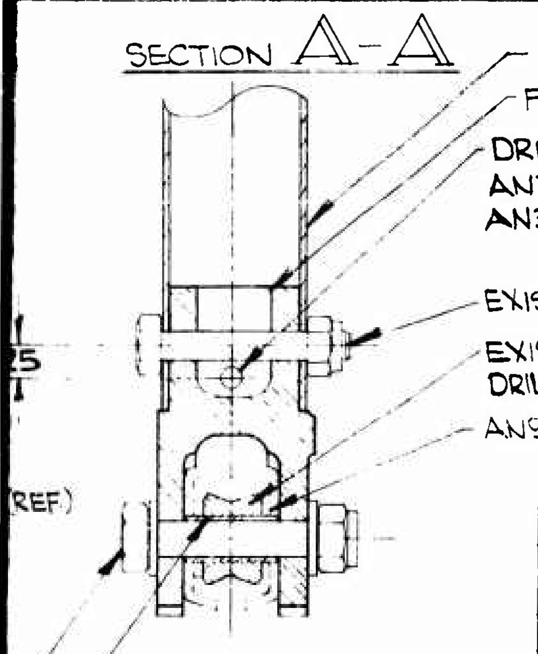
Seat Position	Resultant Failure Accelerations
Full down	29.8G
Med. low	26.4G
Med. high	24.1G
Full up	22.4G



7. REASSEMBLE IDENTICAL TO EXISTING ARRANGEMENT
6. THE CUT OFF PORTIONS OF 204-070-742
   TO REMAIN IN PLACE ON REASSEMBLY !
5. DRILL OUT EXISTING ROLLER TO .47 DIA.
4. DRILL NEW 3/16 DIA HOLE THRU TUBE AND FITTING
3. SAWCUT FITTING AS SHOWN
2. REPLACE EXISTING SPACER WITH NAS43-5-53
1. REMOVE FITTING, 1.25" STEEL TUBE, AND CARRIAGE CHANNEL FROM SEAT

MODIFICATION PROCEDURE:

2



TOTAL NO. REQ PER A/C	FLAG NOTE	PART NUMBER	PART NAME	MATERIAL	STOCK	GOVT SPEC.	DIA.	THK	WIDTH	LGTH	FINAL TEMPER	UNIT WT.
4		NAS43-5-53	SPACER									
8		AN960-716	WASHER									
8		AN960 PD516L	WASHER									
4		AN365-5	NUT									
4		AN365-1032	NUT									
4		AN5-16A	BOLT									
4		AN3-15A	BOLT									

LIST OF MATERIALS

DIMENSIONAL TOLERANCE UNLESS OTHERWISE SPECIFIED:
DECIMALS: .X ±0.10 ANGLES: ±1 DEGREE
.XX ±0.03
.XXX ±0.010

DRAFT	DATE		
CHERRON	8-2-62	MODIFICATION AFT CARRIAGE ATTACHMENT, CREW SEAT	AVIATION CRASH INJURY RESEARCH A DIVISION OF FLIGHT SAFETY FOUNDATION PHOENIX, ARIZ.
STRESS: J. Avery			
APPROV.: J. L. Haley Jr.	8 Aug, 62		
NEXT ASSEM: HU-1-10		AIRCRAFT: HU-1 / SCALE: FULL SIZE	HU-1-12

5829-62

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USCONARC	9
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Second US Army	2
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Sixth US Army	1
USAIC	2
USACGSC	1
USAWC	1
USAATBD	1
USAARMBD	1
USAAVNBD	1
USATMC (FTZAT), ATO	1
USAPRDC	1
DCSLOG	4
Rsch Anal Corp	1
ARO, Durham	2
OCRD, DA	2
USATMC Nav Coord Ofc	1
Ofc of Maint Engr, ODDR&E, OSD	1
NATC	2
ARO, OCRD	2
CRD, Earth Scn Div	1
CG, USAAVNC	2
USAAVNS, CDO	1
DCSOPS	1
USAOMC	1
OrdBd	1
QM Comb Dev Ag	1
QMRECOMD	1
QMFSA	1
SigBd	1
CofT	8
USATCDA	1
USATB	1
USATMC	20
USATTC	4
USATSCH	5
USATRECOM	41
USA Tri Ser Pr[illegible]	1
USATTCA	1

TCLO, USAABELCTBD	1
USASRDL LO, USCONARC	2
USATTCP	1
OUSARMA	1
USATRECOM LO, USARDG (EUR)	2
USAEWES	2
TCLO, USAAVNS	1
USATDS	5
USARPAC	1
EUSA	1
USARYIS/IX CORPS	2
USATAJ	6
USARHAW	3
ALFSEE	2
USACONZEUR	3
USARCARIB	4
AFSC (SCS-3)	1
APGC(PGAPI)	1
Air Univ Lib	1
AFSC(Aero Sys Div)	2
ASD (ASRMPT)	1
CNO	1
CNR	3
BUWEPS, DN	5
ACRD(OW), DN	1
BUY&D, DN	1
USNPGSCH	1
CMC	1
MCLFDC	1
MCEC	1
MCLO, USATSCH	1
USCG	1
USASGCA	1
Canadian LO, USATSCH	3
BRAS, DAQMG(Mov & Tn)	4
USASG, UK	1
NAFEC	3
Langley Rsch Cen, NASA	3
Geo C. Marshall Sp Flt Cen, NASA	1
MSC, NASA	1
NASA, Wash., D. C.	6
Ames Rsch Cen, NASA	2
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DAA	3
ODCSOPS, ASD	2
ODCSPER, DS	1
USATAFOfc	2
BMS, AMSFTBr	2
BMS, AMTDiv	1
SG- AvnBr	5
AFIP	2
Hq, USMC	1
ONRsch	2
CNAFB, USAFDFSR	1
USABdAvnAccRsch	5
USAAHRU	1
USAR, USNASC	1
DUSNASC, NAS	2
NavAMC	3
NADC	1
WADD	2
ASML	2
DCA, USATRECOM	1
NASA Hq	1
CARI, FAA	2
NLM	2
AF Fli Ts Cen	2
HUSTWO	2
ARDS, FAA	2
BFS, FAA	2
BAM, FAA	2
NAFECen	1
BofS, Civ Aero Bd	2
APD, USPHS	2
APRSS, Div Rsch Gr	2
FSFI	5
AVCIR	100
USSTRICOM	1
MOCOM	3

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Report is made of stress analysis conducted on the crew seat (cont'd.)

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